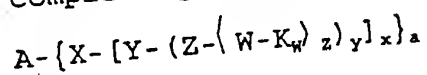


## Claims

1. A cascade polymer complex comprising  
 a) a complexing ligand of general formula I



in which

A stands for a nitrogen-containing cascade nucleus  
 of base multiplicity a,

X and Y, independently of one another, stand for a  
 direct bond or a cascade reproduction unit of  
 reproduction multiplicity x or y,

Z and W, independently of one another, stand for a  
 cascade reproduction unit of reproduction  
 multiplicity z or w,

K stands for the radical of a complexing agent,

a stands for numbers 2 to 12,

x, y, z and w, independently of one another, stand for  
 numbers 1 to 4,

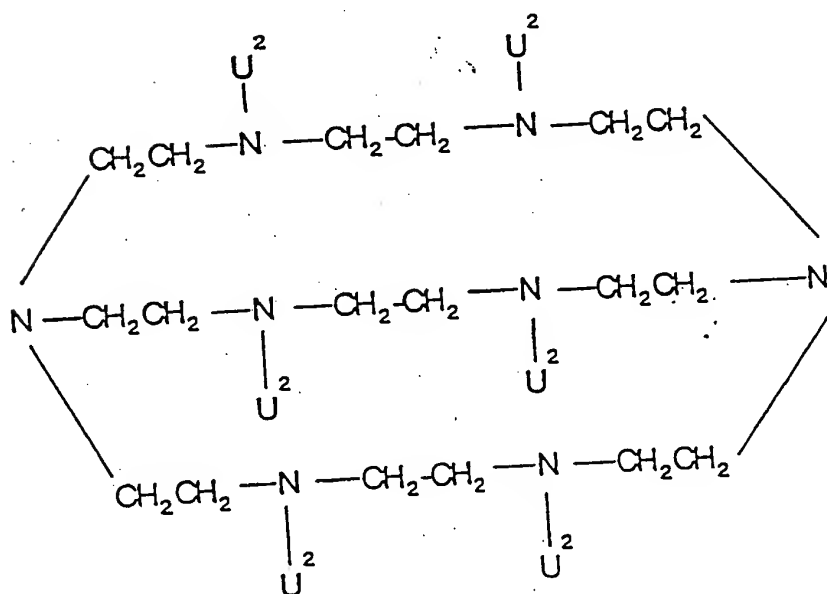
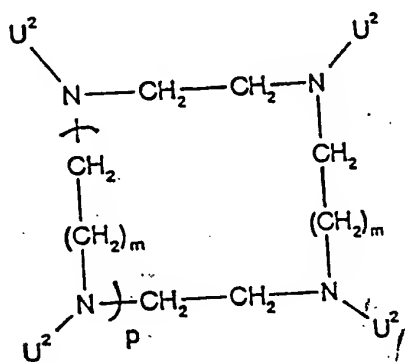
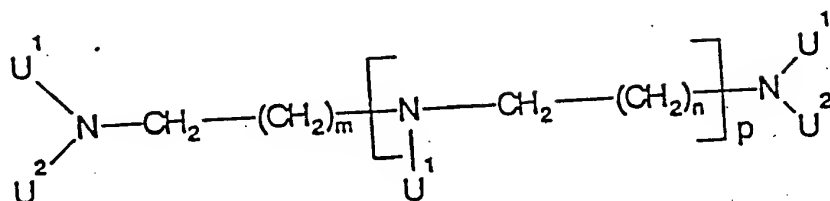
provided that at least two cascade reproduction units  
 are different and that for the product of the  
 multiplicities,

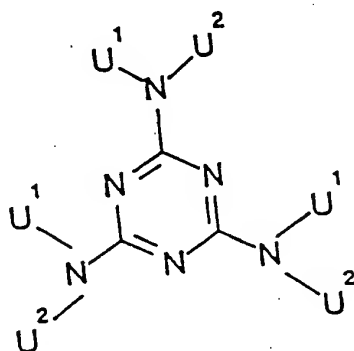
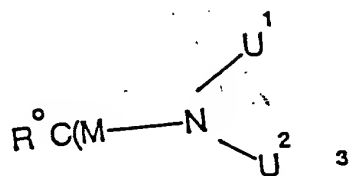
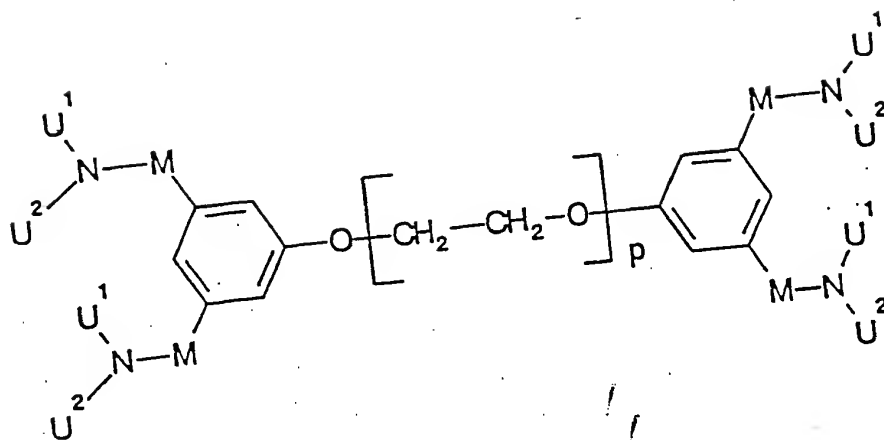
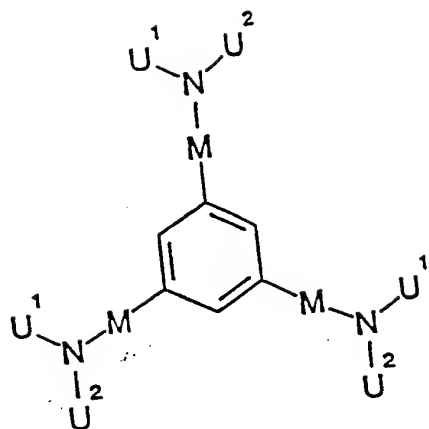
$$16 \leq a \cdot x \cdot y \cdot z \cdot w \leq 64$$

holds true,

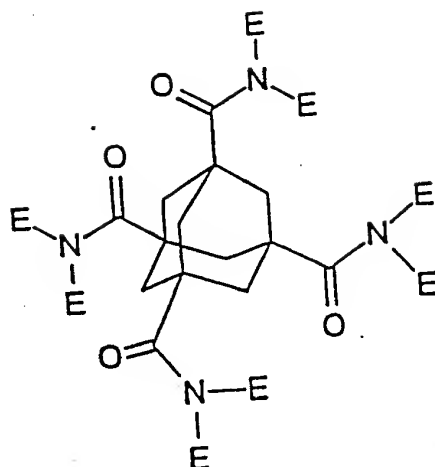
- b) at least 16 ions of an element of atomic numbers  
 20 to 29, 39, 42, 44 or 57-83,  
 c) optionally one or more cations of inorganic and/or  
 organic bases, amino acids or amino acid amides and  
 d) optionally, one or more acylated terminal amino groups

2. A cascade polymer complex according to claim 1,  
wherein A means a nitrogen atom,





or



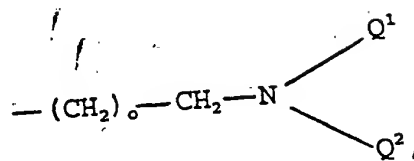
in which

m and n independently stand for numbers 1 to 10,

p stands for numbers 0 to 10,

U<sup>1</sup> stands for Q<sup>1</sup> or E,U<sup>2</sup> stands for Q<sup>2</sup> or E with

E meaning the group



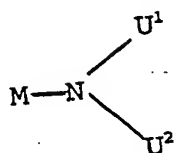
whereby

o stands for numbers 1 to 6,

Q<sup>1</sup> stands for a hydrogen atom or Q<sup>2</sup> andQ<sup>2</sup> stands for a direct bond,

M stands for a C<sub>1</sub>-C<sub>10</sub> alkylene chain which optionally is interrupted by 1 to 3 oxygen atoms and/or optionally is substituted with 1 to 2 oxo groups,

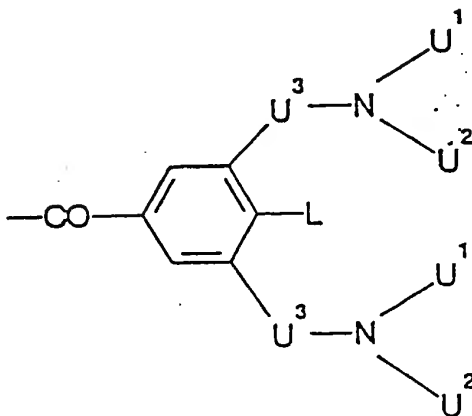
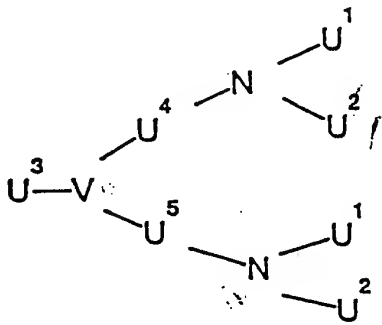
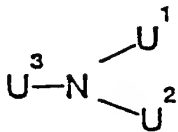
$R^\circ$  stands for a branched or unbranched  $C_1-C_{10}$  alkyl radical, a nitro, amino, carboxylic acid group or for



whereby the number of  $Q^2$  elements corresponds to base multiplicity a.

3. A cascade polymer complex according to claim 1, wherein cascade reproduction units X, Y, Z and W, independently of one another, stand for

E,

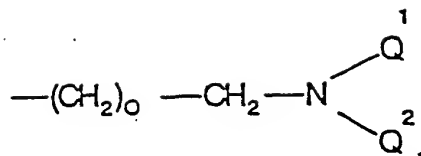


in which

$U^1$  stands for  $Q^1$  or E,

$U^2$  stands for  $Q^2$  or E with

E meaning the group



whereby

$o$  stands for numbers 1 to 6,

$Q^1$  stands for a hydrogen atom or  $Q^2$ ,

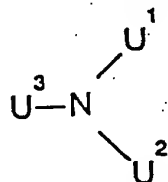
$Q^2$  stands for a direct bond,

$U^3$  stands for a  $C_1$ - $C_{20}$  alkylene chain, which optionally is interrupted by 1 to 10 oxygen atoms and/or 1 to 2 -  $N(CO)_q$ - $R^2$  radicals, 1 to 2 phenylene radicals and/or 1 to 2 phenylenoxy radicals and/or optionally is substituted by 1 to 2 oxo, thioxo, carboxy,  $C_1$ - $C_5$  alkylcarboxy,  $C_1$ - $C_5$  alkoxy, hydroxy, or  $C_1$ - $C_5$  alkyl groups, whereby

$q$  stands for numbers 0 or 1

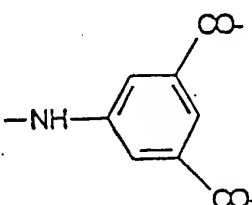
$R^2$  stands for a hydrogen atom, or a methyl or an ethyl radical, which optionally is substituted with 1-2 hydroxy or 1 carboxy group(s),

$L$  stands for a hydrogen atom or the group



$V$  stands for methine group  $\begin{array}{c} | \\ -CH, \text{ if at the} \\ | \end{array}$

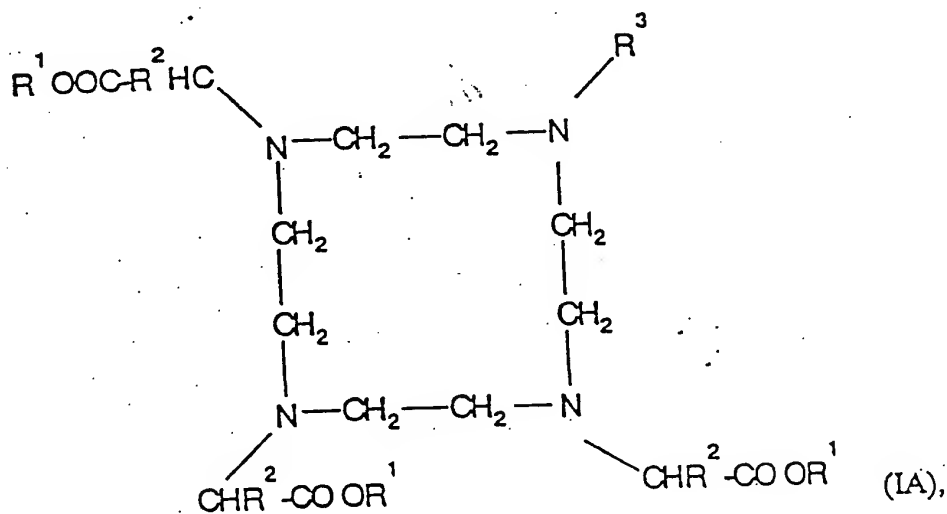
same time  $U^4$  means a direct bond or group M  
and  $U^5$  has one of the meanings of  $U^3$   
or

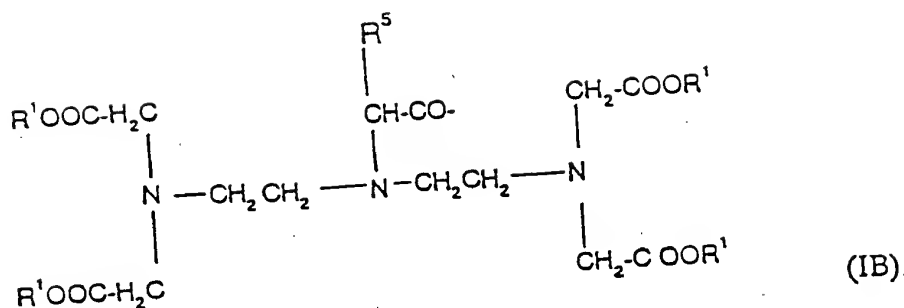
V stands for group , if at the

same time  $U^4$  and  $U^5$  are identical and mean the  
direct bond or group M, and

M stands for a  $C_1$ - $C_{10}$  alkylene chain which optionally is  
interrupted by 1 to 3 oxygen atoms and/or optionally is  
substituted with 1 to 2 oxo groups.

4. A cascade polymer complex according to claim 1, wherein  
complexing agent radical K bound to the terminal nitrogen atoms  
of the last generation of reproduction unit W stands for a  
radical of general formulas IA or IB



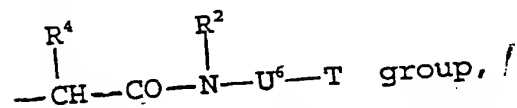


in which

$\text{R}^1$ , independently of one another, stand for a hydrogen atom or a metal ion equivalent of atomic numbers 20-29, 39, 42-44 or 57-83,

$\text{R}^2$  stands for a hydrogen atom, or a methyl or an ethyl radical, which optionally is substituted with 1-2 hydroxy or 1 carboxy group(s),

$\text{R}^3$  stands for a



$\text{R}^4$  stands for a straight-chain, branched, saturated or unsaturated  $\text{C}_1\text{-C}_{30}$  alkyl chain, which optionally is interrupted by 1-10 oxygen atoms, 1 phenylene group, or 1 phenylenoxy group and/or optionally substituted by 1-5 hydroxy, 1-3 carboxy, or 1-phenyl group(s),

$\text{R}^5$  stands for a hydrogen atom or for  $\text{R}^4$ ,

$\text{U}^6$  stands for a straight-chain, branched, saturated or unsaturated  $\text{C}_1\text{-C}_{20}$  alkylene group optionally containing 1-5 imino, 1-3 phenylene, 1-3 phenylenoxy, 1-3 phenylenimino, 1-5 amide, 1-2 hydrazide, 1-5 carbonyl,



1-5 ethylenoxy, 1 urea, 1 thiourea, 1-2 carboxyalkylimino, 1-2 ester groups, and/or 1-10 oxygen, 1-5 sulfur and/or 1-5 nitrogen atom(s) and/or optionally substituted by 1-5 hydroxy, 1-2 mercapto, 1-5 oxo, 1-5 thioxo, 1-3 carboxy, 1-5 carboxyalkyl, 1-5 ester and/or 1-3 amino group(s), whereby the phenylene groups that are optionally contained can be substituted by 1-2 carboxy, 1-2 sulfo or 1-2 hydroxy groups,

T stands for a  $-\text{CO}-\alpha$ ,  $-\text{NHCO}-\alpha$  or  $-\text{NHCS}-\alpha$  group and  
 $\alpha$  stands for the bonding site to the terminal nitrogen atoms of the last generation of reproduction unit W.

5. A cascade polymer complex according to claim 4, wherein the  $\text{C}_1$ - $\text{C}_{20}$  alkylene chain that stands for  $\text{U}^6$  contains the groups  $-\text{CH}_2$ ,  $-\text{CH}_2\text{NHCO}$ ,  $-\text{NHCOCH}_2\text{O}$ ,  $-\text{NHCOCH}_2\text{OC}_6\text{H}_4$ ,  $-\text{N}(\text{CH}_2\text{CO}_2\text{H})$ ,  $-\text{NHCOCH}_2\text{C}_6\text{H}_4$ ,  $-\text{NHCSNHC}_6\text{H}_4$ ,  $-\text{CH}_2\text{OC}_6\text{H}_4$ , or  $-\text{CH}_2\text{CH}_2\text{O}$  and/or is substituted by groups  $-\text{COOH}$ , or  $-\text{CH}_2\text{COOH}$ .

6. A cascade polymer complex according to claim 4, wherein  $\text{U}^6$  stands for a

$-\text{CH}_2$ ,  $-\text{CH}_2\text{CH}_2$ ,  $-\text{CH}_2\text{CH}_2\text{CH}_2$ ,  $-\text{C}_6\text{H}_4$ ,  $-\text{C}_6\text{H}_{10}$ ,  $-\text{CH}_2\text{C}_6\text{H}_5$ ,  
 $-\text{CH}_2\text{NHCOCH}_2\text{CH}(\text{CH}_2\text{CO}_2\text{H})-\text{C}_6\text{H}_4$ ,  
 $-\text{CH}_2\text{NHCOCH}_2\text{OCH}_2$ , or  
 $-\text{CH}_2\text{NHCOCH}_2\text{C}_6\text{H}_4$

group.

7. A cascade polymer complex according to claim 3, wherein radical  $\text{U}^3$  contained in cascade reproduction units X, Y, Z and W stands for

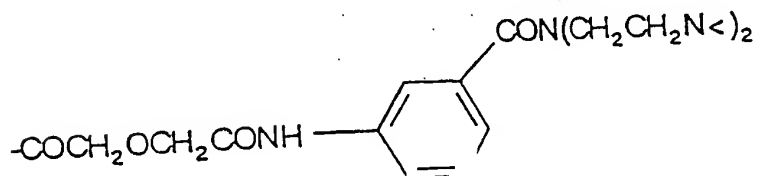
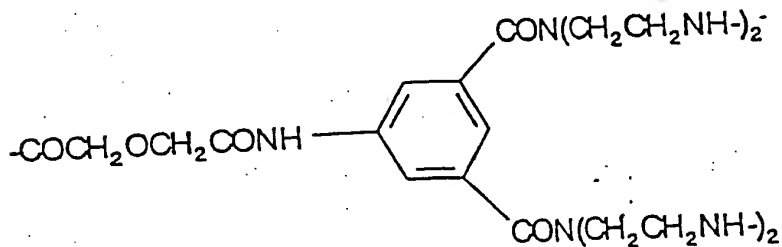
$-\text{CO}-$ ,  $-\text{COCH}_2\text{OCH}_2\text{CO}-$ ,  $-\text{COCH}_2-$ ,  $-\text{CH}_2\text{CH}_2-$ ,  $-\text{CONHC}_6\text{H}_4-$ ,

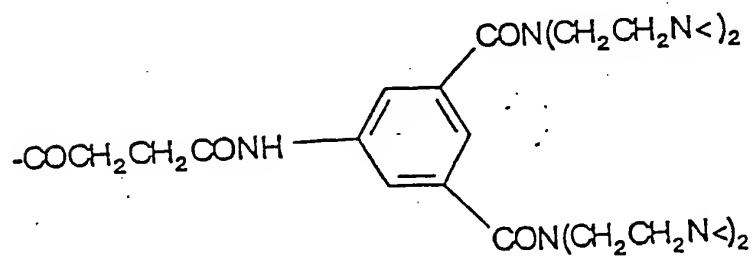
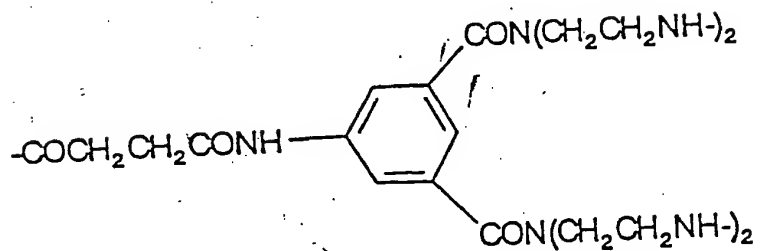
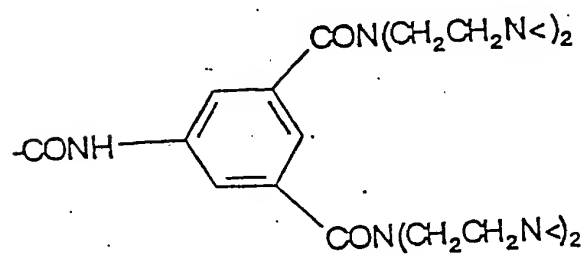
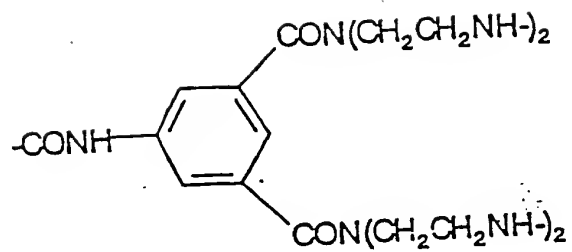
-COCH<sub>2</sub>CH<sub>2</sub>CO-, -COCH<sub>2</sub>-CH<sub>2</sub>CH<sub>2</sub>CO-, or -COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CO-,  
 radical U<sup>4</sup> stands for a direct bond, or for -CH<sub>2</sub>CO-,  
 radical U<sup>5</sup> stands for a direct bond, -(CH<sub>2</sub>)<sub>4</sub>-, -CH<sub>2</sub>CO-,  
 -CH(COOH)-, CH<sub>2</sub>OCH<sub>2</sub>CH<sub>2</sub>-, -CH<sub>2</sub>C<sub>6</sub>H<sub>4</sub>-, or CH<sub>2</sub>-C<sub>6</sub>H<sub>4</sub>OCH<sub>2</sub>CH<sub>2</sub>-,  
 Q<sup>1</sup>

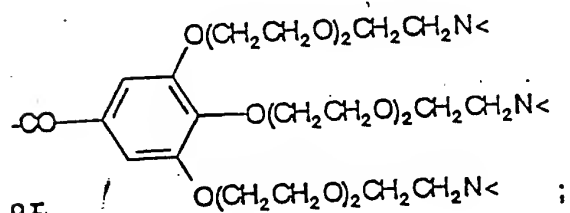
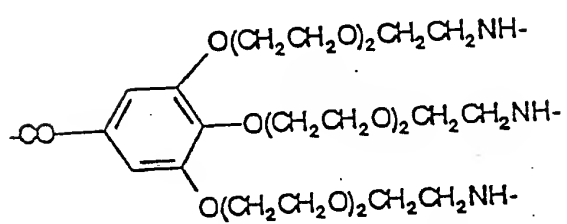
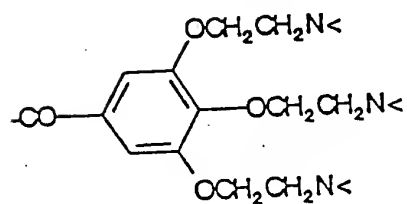
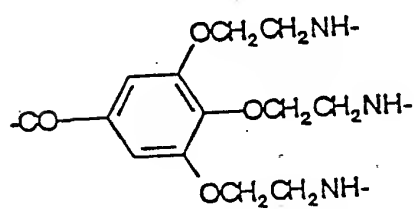
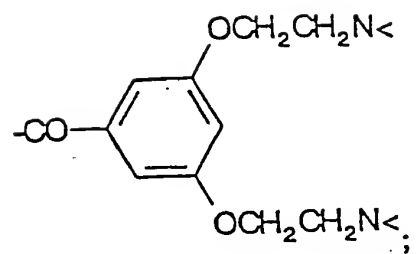
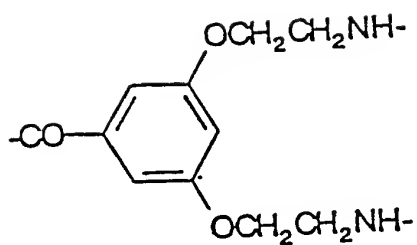
radical E stands for a group ---CH<sub>2</sub>---CH<sub>2</sub>---N  
 Q<sup>2</sup>.

8. A cascade polymer complex according to claim 3, wherein cascade reproduction units X, Y, Z and W, independently of one another, stand for

-CH<sub>2</sub>CH<sub>2</sub>NH-; -CH<sub>2</sub>CH<sub>2</sub>N<;  
 -COCH(NH-)(CH<sub>2</sub>)<sub>4</sub>NH-; -COCH(N<)(CH<sub>2</sub>)<sub>4</sub>N<;  
 -COCH<sub>2</sub>OCH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>NH-)<sub>2</sub>; -COCH<sub>2</sub>OCH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>N<)<sub>2</sub>;  
 -COCH<sub>2</sub>N(CH<sub>2</sub>CH<sub>2</sub>NH-)<sub>2</sub>; -COCH<sub>2</sub>N(CH<sub>2</sub>CH<sub>2</sub>N<)<sub>2</sub>;  
 -COCH<sub>2</sub>NH-; -COCH<sub>2</sub>N<;  
 -COCH<sub>2</sub>CH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>NH-)<sub>2</sub>; -COCH<sub>2</sub>CH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>N<)<sub>2</sub>;  
 -COCH<sub>2</sub>OCH<sub>2</sub>CONH-C<sub>6</sub>H<sub>4</sub>-CH[CH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>NH-)<sub>2</sub>]<sub>2</sub>;  
 -COCH<sub>2</sub>OCH<sub>2</sub>CONH-C<sub>6</sub>H<sub>4</sub>-CH[CH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>N<)<sub>2</sub>]<sub>2</sub>;  
 -COCH<sub>2</sub>CH<sub>2</sub>CO-NH-C<sub>6</sub>H<sub>4</sub>-CH[CH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>NH-)<sub>2</sub>]<sub>2</sub>;  
 -COCH<sub>2</sub>CH<sub>2</sub>CO-NH-C<sub>6</sub>H<sub>4</sub>-CH[CH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>N<)<sub>2</sub>]<sub>2</sub>;  
 -CONH-C<sub>6</sub>H<sub>4</sub>-CH[CH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>NH-)<sub>2</sub>]<sub>2</sub>;  
 -CONH-C<sub>6</sub>H<sub>4</sub>-CH[CH<sub>2</sub>CON(CH<sub>2</sub>CH<sub>2</sub>N<)<sub>2</sub>]<sub>2</sub>;  
 -COCH(NH-)CH(COOH)NH-; -COCH(N<)CH(COOH)N<;







; or

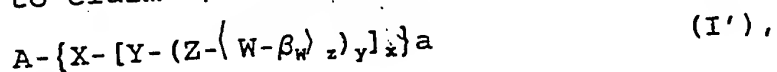
9. A cascade polymer complex according to claim 2, wherein
- m stands for numbers 1-3,
  - n stands for numbers 1-3,
  - o stands for number 1,
  - p stands for numbers 0-3,
  - M stands for a  $-\text{CH}_2$ ,  $-\text{CO}$  or  $-\text{CH}_2\text{CO}$  group and
  - $\text{R}^\circ$  stands for a  $-\text{CH}_2\text{NU}^1\text{U}^2$ ,  $\text{CH}_3$  or  $\text{NO}_2$  group.

10. A pharmaceutical agent comprising at least one cascade polymer complex according to claim 1, and a pharmaceutically acceptable carrier.

11. A method of NMR diagnosis, e.g., imaging or diagnostic radiology, e.g., CT imaging, comprising administering at least one polymer complex according to claim 1.

12. A method for differentiating benign and malignant tumors in regions of the body without blood-brain barriers comprising imaging such tumors by administering a cascade polymer complex according to claim 1.

13. Process for the production of cascade polymer complexes according to claim 1, wherein compounds of general formula I'



in which

A stands for a nitrogen-containing cascade nucleus of base multiplicity a,

X and Y, independently of one another, stand for a direct bond or a cascade reproduction unit of reproduction multiplicity x or y,

z and w, independently of one another, stand for a cascade reproduction unit of reproduction multiplicity z or w,

a stands for numbers 2 to 12,

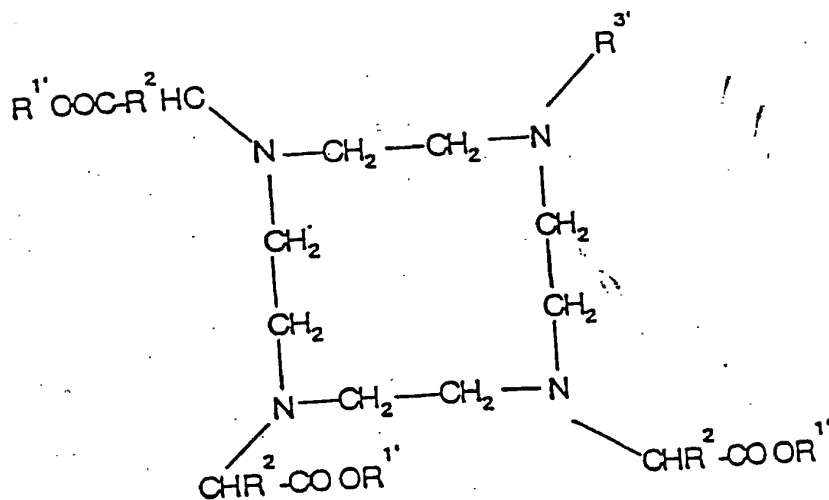
x, y, z and w, independently of one another, stand for numbers 1 to 4 and

$\beta$  stands for the bonding site of the terminal NH groups of the last generation, of reproduction unit w, provided that at least two reproduction units are different and that for the product of the multiplicities,

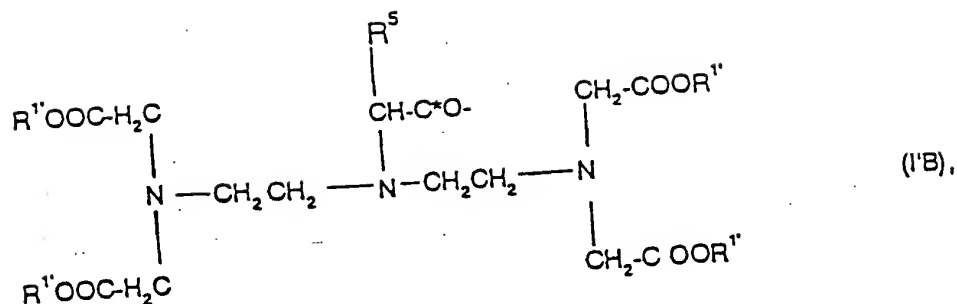
$$16 \leq a \cdot x \cdot y \cdot z \cdot w \leq 64$$

holds true,

are reacted with a complex of complexing agent K' of general formula I'A or I'B



(I'A)

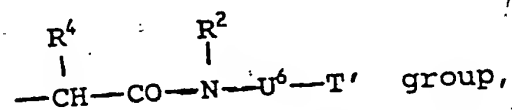


whereby

$\text{R}^1$ , independently of one another, stand for a hydrogen atom, a metal ion equivalent of atomic numbers 20-29, 39, 42-44, or 57-83 or an acid protective group,

$\text{R}^2$  stands for a hydrogen atom, a methyl or an ethyl radical, which optionally is substituted with 1-2 hydroxy or 1 carboxy group(s),

$\text{R}^3$  stands for a



$\text{R}^4$  stands for a straight-chain, branched, saturated or unsaturated  $\text{C}_1$ - $\text{C}_{30}$  alkyl chain, which optionally is interrupted by 1-10 oxygen atoms, 1 phenylene group, 1 phenylenoxy group and/or optionally substituted by 1-5 hydroxy, 1-3 carboxy, 1-phenyl group(s),

$\text{R}^5$  stands for a hydrogen atom or for  $\text{R}^4$ ,

$\text{U}^6$  stands for a straight-chain, branched, saturated or unsaturated  $\text{C}_1$ - $\text{C}_{20}$  alkylene group optionally containing 1-5 imino, 1-3 phenylene, 1-3 phenylenoxy, 1-3

phenylenimino, 1-5 amide, 1-2 hydrazide, 1-5 carbonyl, 1-5 ethylenoxy, 1 urea, 1 thiourea, 1-2 carboxyalkylimino, 1-2 ester groups; 1-10 oxygen, 1-5 sulfur and/or 1-5 nitrogen atom(s) and/or optionally substituted by 1-5 hydroxy, 1-2 mercapto, 1-5 oxo, 1-5 thioxo, 1-3 carboxy, 1-5 carboxyalkyl, 1-5 ester and/or 1-3 amino group(s), whereby the phenylene groups that are optionally contained can be substituted by 1-2 carboxy, 1-2 sulfo or 1-2 hydroxy groups,

T' stands for a  $-C^*O$ ,  $-COOH$ ,  $-N=C=O$  or  $-N=C=S$  group, and  $C^*O$  stands for an activated carboxyl group

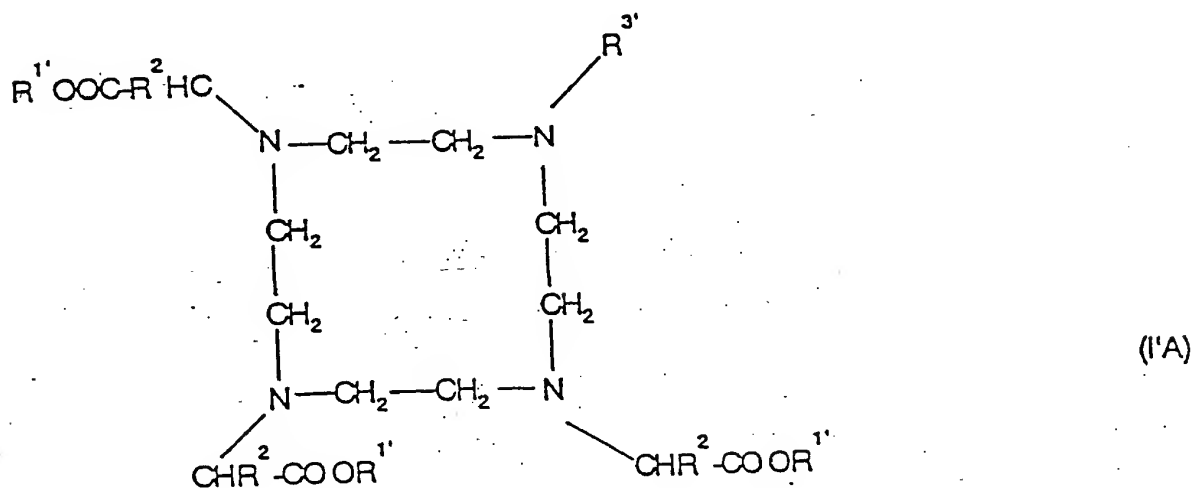
provided that -- if K' stands for a complex -- at least two (in the case of divalent metals) or three (in the case of trivalent metals) of substituents  $R^1$  stand for a metal ion equivalent of the above-mentioned elements and that optionally other carboxyl groups are present in the form of their salts with inorganic and/or organic bases, amino acids or amino acid amides,

optionally present protective groups are cleaved, the thus obtained cascade polymers -- if K' stands for a complexing agent -- are reacted in a way known in the art with at least one metal oxide or metal salt of an element of atomic numbers 20-29, 39, 42, 44, or 57-83 and optionally then in the cascade polymer complexes thus obtained, acid hydrogen atoms that are still present are completely or partially substituted by cations of inorganic and/or organic bases, amino acids, or amino acid amides



and optionally still present free terminal amino groups are optionally acylated -- before or after the metal complexing.

14. A compound of general formula I'A

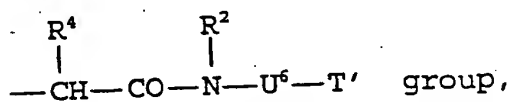


wherein

$\text{R}^1$ , independently of one another, stand for a hydrogen atom, a metal ion equivalent of atomic numbers 20-29, 39, 42-44 or 57-83 or an acid protective group,

$\text{R}^2$  stands for a hydrogen atom, or a methyl or an ethyl radical, which optionally is substituted with 1-2 hydroxy or 1 carboxy group(s),

$\text{R}^3$  stands for a



$\text{R}^4$  stands for a straight-chain, branched, saturated or unsaturated  $\text{C}_1\text{-C}_{30}$  alkyl chain, which optionally is interrupted by 1-10 oxygen atoms, 1 phenylene group, or

1 phenylenoxy group and/or optionally is substituted by 1-5 hydroxy, 1-3 carboxy, or 1-phenyl group(s),  
 U<sup>6</sup> stands for a straight-chain, branched, saturated or unsaturated C<sub>1</sub>-C<sub>20</sub> alkylene group optionally containing 1-5 imino, 1-3 phenylene, 1-3 phenylenoxy, 1-3 phenylenimino, 1-5 amide, 1-2 hydrazide, 1-5 carbonyl, 1-5 ethylenoxy, 1 urea, 1 thiourea, 1-2 carboxyalkylimino, 1-2 ester groups and/or 1-10 oxygen, 1-5 sulfur and/or 1-5 nitrogen atom(s) and/or optionally substituted by 1-5 hydroxy, 1-2 mercapto, 1-5 oxo, 1-5 thioxo, 1-3 carboxy, 1-5 carboxyalkyl, 1-5 ester and/or 1-3 amino group(s), wherein the phenylene groups that are optionally contained can be substituted by 1-2 carboxy, 1-2 sulfo or 1-2 hydroxy groups,

T' stands for a -C\*O, -COOH, -N=C=O or -N=C=S group, and

C\*O stands for an activated carboxyl group.

15. Process for the production of pharmaceutical agents according to claim 10, wherein the cascade polymer complexes, dissolved or suspended in water or physiological salt solution, optionally with the additives that are commonly used in galenicals, are brought into a form suitable for enteral or parenteral administration.